



# Washington State Enhanced Hazard Mitigation Plan

## Risk Assessment

The Risk Assessment of the Washington State Hazard Mitigation Plan (SHMP) provides the factual basis for the mitigation goals and activities proposed by the plan. This section examines the nine natural hazards that impact the state, determines which counties and populations are most vulnerable to each hazard, and estimates potential losses of state facilities for selected hazards. This section also contains four new hazard profiles within the Man-Made/Technological section.

The Risk Assessment consists of two parts – 1) profiles of nine natural and four man-made hazards 2) socio-economic profiles of the nine regions of the state. The Natural Hazard Profiles describe and document the impact of past hazard events and identifies jurisdictions most at risk to that hazard. Profiles for earthquake, flood, tsunami, wildfire and volcano continue to identify potential losses of state facilities caused by hazard events; however, during the 2010 plan update, the same information is now provided for landslide and wildland fire (note: these are the hazards for which scientific hazard zone data exists, and allows for identification of at-risk facilities within hazard zones). This information is not included for the man-made hazards during the 2010 plan update. Each Regional Profile describes the setting of the region, notes potential at-risk populations, and identifies potential losses of state facilities by hazard within the region.

Special note – As was the case with previous plan editions, the 2010 Risk Assessment does not use estimates of potential losses from local hazard mitigation plans in its methodology to determine which jurisdictions are at greatest risk to various hazards. This stems from two major factors. First, few local plans included such information because it is not required by federal planning regulations [see 44 CFR 201.6.c.2.ii]. Local plans are required to provide only a summary of each hazard and its impact on communities. Second, for those jurisdictions that do provide some dollar value loss estimations, the method of gaining such information in many instances is skewed. For example, one jurisdiction that did provide dollar value loss estimations indicated 100% destruction for all hazards. Obviously, while this may be true for some hazards such as an earthquake, it is not necessarily true for other hazards, such as flooding. While some portions of multi-story buildings may be impacted by a flood, the entire building may not have been 100% destroyed. Similarly for severe winter storms where not all areas within the county are 100% impacted, the jurisdiction indicates 100% destruction for the hazard. Therefore, much of the data contained in the local plans was not a viable option for use in determining loss estimation. While the state is required to provide an overview and analysis of potential losses to identified structures based on estimates in local risk assessments [see 44 CFR 201.4.c.2.iii], the state is unable to use most of the

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available information because local plans currently lack the necessary detail and accuracy for such an analysis to be performed.

In an effort to rectify this deficiency, the WA EMD took three separate proactive measures in an attempt to assist the locals in their efforts, as well as provide the state a method to conduct a more in-depth and accurate risk assessment.

First, WA EMD provided Risk Analysis Training, which was held on two separate dates and was attended by in excess of 40 students, representing multiple jurisdictions statewide. It is hoped that by providing this training, the next plan editions by the locals will include more viable data, making it possible for the state to utilize their data for an accurate loss estimation statewide.

Second, Washington State EMD applied for and was awarded a grant to assist in the gathering of data to enhance our ability to perform GIS risk analysis at the local level. Military Department Staff worked closely with Washington State Department of Natural Resources, the agency which was contracted with to gather the data from all 39 Washington Counties. This data was gathered directly from local jurisdictions, school districts, and various other sources with the intent to utilize the data to conduct a more in-depth risk assessment at the local level. (A detailed description of the process involved and an analysis of the level of data captured is included in Tab 11, *Best Practices*, as well as within the *Coordination of Local Plans* section, below.) However, due to the time frame involved with grant award (project completion March 31, 2010) and the update of the SHMP (submission date to FEMA May 2010), the project timeline coincided too closely with the completion of the state's plan, and, therefore, we were not able to utilize a large portion of the data received as much of the data had not yet incorporated into an appropriate format for use in this risk assessment. The project has continued forward, and data is now available for use by some of the local jurisdictions to incorporate into their planning efforts. This data, if used by the local jurisdictions, will greatly enhance their level of accuracy with respect to essential/critical facilities once the local jurisdictions incorporate dollar values to the captured facilities data.

It is anticipated that jurisdictions will begin to utilize the new data gathered, along with the method of risk assessment incorporated within the SHMP, which will help capture dollar losses. The level of accuracy should be detailed enough to provide reasonable loss estimations within the local plans. The intent during the 2010-2013 SHMP update cycle is to compare what the local jurisdictions estimate their losses to be to the State's assessment of losses.

Third, within the 2010 plan update, a simple risk assessment has been incorporated and used for the state's analysis. This risk assessment, once developed, was distributed to 25(+) jurisdictions and private consultants statewide to gather input on the usability of the document. Response to the tool was very favorable; many jurisdictions reviewing the assessment indicated they will include this, or a very similar assessment, within their next update.

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### I. Identifying and Profiling Hazards

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**Requirement 44 CFR §201.4(c)(2)(i): *Plan Content.*** To be effective the plan must include an overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate.

#### **2010 Plan Update Information:**

Identification of nine natural hazards contained within the 2007 SHMP continues to provide the foundation for the 2010 Risk Assessment of the SHMP. These hazards are:

Avalanche  
Flood  
Tsunami

Drought  
Landslide  
Volcano

Earthquake  
Severe Storm  
Wildland Fire

This Risk Assessment includes a profile of each of the nine natural hazards. Each profile provides a detailed description of the hazard and its impact on the state; identifies local jurisdictions most vulnerable to future hazard events; and, for earthquake, flood, landslide, tsunami, wildfire and volcano hazards, identifies state facilities potentially at risk to losses during hazard events. New to the 2010 edition are four man-made hazards: Climate Change, Dam Safety, Hazardous Materials and Public Health. Each of the four new profiles provides information on the hazard and previous occurrences within the State, but provides no loss estimation, probability of future occurrence, or risk assessment identifying local jurisdictions vulnerable to future hazard events.

In addition to the nine natural hazards, the Risk Assessment for the 2010 plan also includes profiles for four new hazards: Climate Change, Dam Safety, Hazardous Materials and Public Health. However, these profiles do not provide the detailed description as the natural hazard profiles, nor do we identify state facilities at risk.

For this edition of the SHMP, staff from the Mitigation and Recovery Section of the State Emergency Management Division (EMD) researched and updated all of the Hazard Profiles with the exception of Drought and Volcano. As no Drought events have occurred since the profile was last updated, it was determined that the profile will remain untouched. The Volcano profile was not amended with the exception of updated maps being inserted. The Mitigation Strategist and GIS Analyst prepared the synopsis of at-risk state facilities that appears at the end of each profile. During the 2010 plan update, subject-matter experts from various disciplines reviewed and updated the various Hazard Profiles. State agencies provided information on their facilities to the Office of Financial Management in a new manner as described in the Planning Process, Tab 2.

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### *Information Sources*

As with previous plan editions, the 2010 Hazard Profiles are again based on a wide range of information and data, including best available science and most current information to describe each hazard and its impacts, and to determine those jurisdictions most vulnerable. The 2010 plan update also includes information from recent studies completed. At the end of each profile is a list of information and data sources; each entry includes publication dates of information and data, as well as Internet URL, if available. New to the 2010 plan edition is Tab 12, *Best Available Sciences*, which also provides a detailed listing of many of the sources used within this plan update, as well as additional sources. It is intended that this section of the plan will be continually updated to maintain a list of resources available for local jurisdictions' use as they update their local plans.

Information used in the Hazard Profiles came from a variety of sources and organizations including, including several new sources for the 2010 edition:

- Historical disaster records and documents, including, but not limited to Hazard Mitigation Survey Team reports and spreadsheets maintained by the State EMD on assistance made available following disasters.
- Literature developed by state and national hazard experts containing best available science and most current knowledge of hazards.
- Available current hazard zone maps, including new ShakeMaps, and Q3 Flood Data.
- Written and oral communication from state and national hazard experts.
- State facilities inventory developed by the Office of Financial Management (OFM), with information provided by state agencies.
- Cascades Volcano Observatory, U.S. Geological Survey (USGS).
- Federal Emergency Management Agency (FEMA).
- Hazard Research Laboratory, Department of Geography, University of South Carolina.
- National Drought Mitigation Center, University of Nebraska-Lincoln.
- National Oceanic and Atmospheric Administration (NOAA) and its agencies/programs:
  - Center for Tsunami Research.
  - International Tsunami Information Center.
  - National Climatic Data Center.

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- National Weather Service (NWS).
  - Northwest Weather and Avalanche Center.
- U.S. Forest Service, U.S. Department of Agriculture.
- USGS, U.S. Department of the Interior.
- US Army Corps of Engineers (new to 2010).
- University of Washington and its departments/programs:
  - Nisqually Earthquake Clearinghouse, Department of Civil and Environmental Engineering (EMD is also a partner in this project).
  - Pacific Northwest Seismic Network, Department of Earth and Space Sciences.
  - Office of the State Climatologist.
- Washington Department of Agriculture.
- Washington Department of Commerce (formerly the Department Community Trade and Economic Development).
- Washington State Department of Health (DOH) (new to 2010).
- Washington State Department of Ecology (DOE) (new divisions within DOE for 2010 plan update edition).
- Washington State Department of Social and Health Services (DSHS) (new to 2010).
- Washington Military Department, EMD.
- Washington Department of Natural Resources (DNR).
- Washington Department of Transportation.
- Western Regional Climate Center, Desert Research Institute.

A list of specific documents and resources used in the development and revision of the Hazard Profiles appears at the end of each profile.

### *Hazard Profile Review*

The EMD Mitigation and Recovery Section directed the review and revision of each Hazard Profile. Mitigation Strategist updated profiles to include significant hazard events that occurred between 2007 and January 31, 2010, added new hazard zone maps created by the GIS Analyst, and updated other information as necessary. Hazard

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experts from a variety of state and federal organizations and academic institutions provided a peer review. The purpose of the expert review was to ensure the accuracy and currency of information presented, to validate the criteria used to identify local jurisdictions most vulnerable to the hazard, and to ensure conformity to federal requirements for this plan. Participating experts, by hazard:

### Avalanche

- Dr. Mark Moore, Director and Avalanche Meteorologist, Northwest Weather and Avalanche Center.

### Drought:

- Eric Hurlbert, Domestic Marketing and Economic Development Chief, Washington Department of Agriculture.

### Earthquake

- Tim Walsh, Chief Geologist, Division of Geology and Earth Resources, Washington DNR.
- Craig Weaver, Seismologist, U.S. Geological Survey.

### Flood

- Dan Sokol, National Flood Insurance Program (NFIP) State Coordinator, Washington Department of Ecology.
- Jerry Franklin, Floodplain Mapping Coordinator, Washington Department of Ecology.
- Chuck Steele, Floodplain Management Specialist, Washington Department of Ecology.

### Landslide

- Dr. Dave Montgomery, Professor, Department of Earth and Space Sciences, and Director, Quaternary Research Center, University of Washington.
- Tim Walsh, Chief Geologist, Division of Geology and Earth Resources, Washington DNR
- Isabelle Y. Sarikhan, Hazard Geologist and GIS Analyst, Division of Geology and Earth Resources, Washington DNR

### Severe Storm

- Ted Buehner, Warning Coordination Meteorologist, NWS, Seattle Forecast Office.
- Tyree Wilde, Warning Coordination Meteorologist, NWS Portland, OR, Forecast Office.
- Anthony Cavallucci, Warning Coordination Meteorologist, NWS Spokane Forecast Office.
- Dennis Hull, Warning Coordination Meteorologist, NWS Spokane Forecast Office.
- Josiah Mault, Assistant State Climatologist, Office of the State Climatologist, University of Washington.

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### Tsunami

- Tim Walsh, Chief Geologist, Division of Geology and Earth Resources, Washington DNR.
- Nathan Wood, Research Geographer, USGS Western Geographic Science Center.
- Brain Atwater, Research Scientist, USGS, and Affiliate Professor, Quarternary Research Center, Department of Earth and Space Sciences, University of Washington.
- Hal Mofjeld, Affiliate Professor, School of Oceanography, University of Washington.
- Dr. Aggeliki Barberopoulou, Researcher, Tsunami Research Center, Viterbi School of Engineering, University of Southern California.

### Volcano

- William Scott, Scientist-in-Charge, Cascades Volcano Observatory, U.S. Geological Survey.

### Wildland Fire

- Jeannie Abbott, Emergency Preparedness Coordinator, Resource Protection Division, Washington DNR.
- Bob Bannon, Natural Resource Program Section Administrator, Resource Protection Division, Washington DNR.

### Man-Made/Technological Hazard Experts:

#### Public Health

- David Owens, Emergency Health and Medical Logistics Manager, Washington State Department of Health
- David Banks, Emergency Response Exercise & Plans Coordinator, Washington State Department of Health
- Dr. Marisa D'Angeli, Washington State Department of Health, CD-Epi Division
- Dave Hodgeboom, Homeland Security Program, Washington State Department of Agriculture.

#### Hazardous Materials

- David Byers, Response Manager, Washington State Department of Ecology
- Sadie Whitener, Environmental Specialist, Washington State Department of Ecology

#### Climate Change

- Spencer Reeder, Environmental Planner, Washington State Department of Ecology

#### Dam Safety

- Doug Johnson, Public Engineer, Washington State Department of Ecology, Dam Safety Program

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### ***Revisions to Hazard Profiles for 2010 Update Cycle:***

Hazard Profiles were revised based on hazard events that took place from 2007 through January 31, 2010, new information on the hazard and its impacts, and a review of how communities identified their vulnerability to hazards in their local mitigation plans (see *Analysis of Local Hazard Vulnerability*, Tab 3, Appendix 1).

Maps within the hazard profiles have been enhanced, with many new maps added. Maps that designate most vulnerable local jurisdictions generally illustrate vulnerability on a broad scale; maps that show specific hazard areas are provided if available (i.e., volcano hazard zones, tsunami inundation zones). When specific areas within a jurisdiction are designated as most vulnerable, descriptions of those areas are in profile text.

Each updated profile includes a summary of the hazard on the first page and significant hazard events that occurred after completion of the 2007 SHMP. Other changes include:

- **Avalanche** – General update of information concerning causes, statistical data and information on avalanche injuries/fatalities from 2006 to July 2009.
- **Drought** – Added information on the 2005 drought, and updated data tables. Updated the list and map of Jurisdictions Most Vulnerable to Drought.
- **Earthquake** – General re-write and update of information by subject matter experts for ease in understanding and comprehension, to include additional scientific studies, but minor in nature as the state experienced no significant earthquakes from 2007 to January 2010.
- **Flood hazard profile** – Updated information to include additional historical disaster events, as well as events occurring since November 2006 flood disaster (which was the latest information included in the 2007 plan edition). Included updated information on floodplain areas statewide. Included a new NFIP section which contains information on the Community Rating System; Repetitive and Severe Repetitive Loss properties; conducted new analysis on jurisdictions most susceptible to flooding based on new data – two new counties added: Wahkiakum and Kittitas.
- **Landslide hazard profile** – General re-write and update of information by subject matter experts for ease in understanding and comprehension, to include additional scientific studies. Added information on significant landslides that occurred from 2006 to January 31, 2010.
- **Severe Storm hazard profile** – Continued emphasis on the two severe storm types previously profiled – high winds and winter storm – as these remain the storms of greatest concern to local jurisdictions. Updated the Jurisdictions Most Vulnerable to these storm types. Brought current the data since the December

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2006 windstorm (latest information included in the 2007 plan edition) which resulted in disaster declarations, as well as the January 2009 Disaster event.

- Tsunami hazard profile – Added information on the December 2004 and March 2005 Indian Ocean earthquake and tsunami events along with a comparison of the geologic feature that generated those events to the Cascadia Subduction Zone off the Pacific Northwest Coast. Added information on the November 2006 tsunami that struck the Pacific coast. Condensed information on historic events in Washington, and corrected information on impacts of the 1964 tsunami. Added new tsunami inundation / evacuation maps; those for outer coast and Strait of Juan de Fuca communities reflect new hazard modeling performed by NOAA in 2005. Added inundation map for Tacoma from March 2006 NOAA modeling data.
- Volcano hazard profile – Updated maps. Remainder of profile was unchanged.
- Wildland fire hazard profile – General review and update of information; updated figures and charts for number of fires and acres burned on state owned and protected lands, and added maps.

### *Hazards of Greatest Concern<sup>1</sup>*

The State Hazard Mitigation Advisory Team (SHMAT) reconfirmed in its review of the SHMP that there are four natural hazards the state should be most concerned about – earthquake, flood, severe storm, and wildland fire. The team made this determination considering the likelihood of occurrence of each hazard and the magnitude of the impacts of likely hazard events. The team was most concerned with hazards with the greatest impacts and recurrence intervals.

During the 2010 plan update process, the SHMAT again reviewed and discussed qualitative risk assessments to rank the hazards in an attempt to provide to the local jurisdictions a method of assessing the data. Due to the fact that Washington State currently has such a large number of jurisdictions embarking upon their first plan update process, as well as several new plans underway, it was determined that some method of a standardized system for conducting risk assessment was needed. In an attempt to provide some guidance in this endeavor, State EMD sponsored two training events conducted by Nathan Wood, PhD of the USGS, who provided several different examples for conducting Risk Assessment. In conjunction with the Risk Assessment training, and in order for EMD to conduct its risk assessment (and also incorporate the risk assessment conducted by the local jurisdictions), EMD Mitigation and Recovery Section embarked upon a new methodology for the 2010 plan update cycle, as follows.

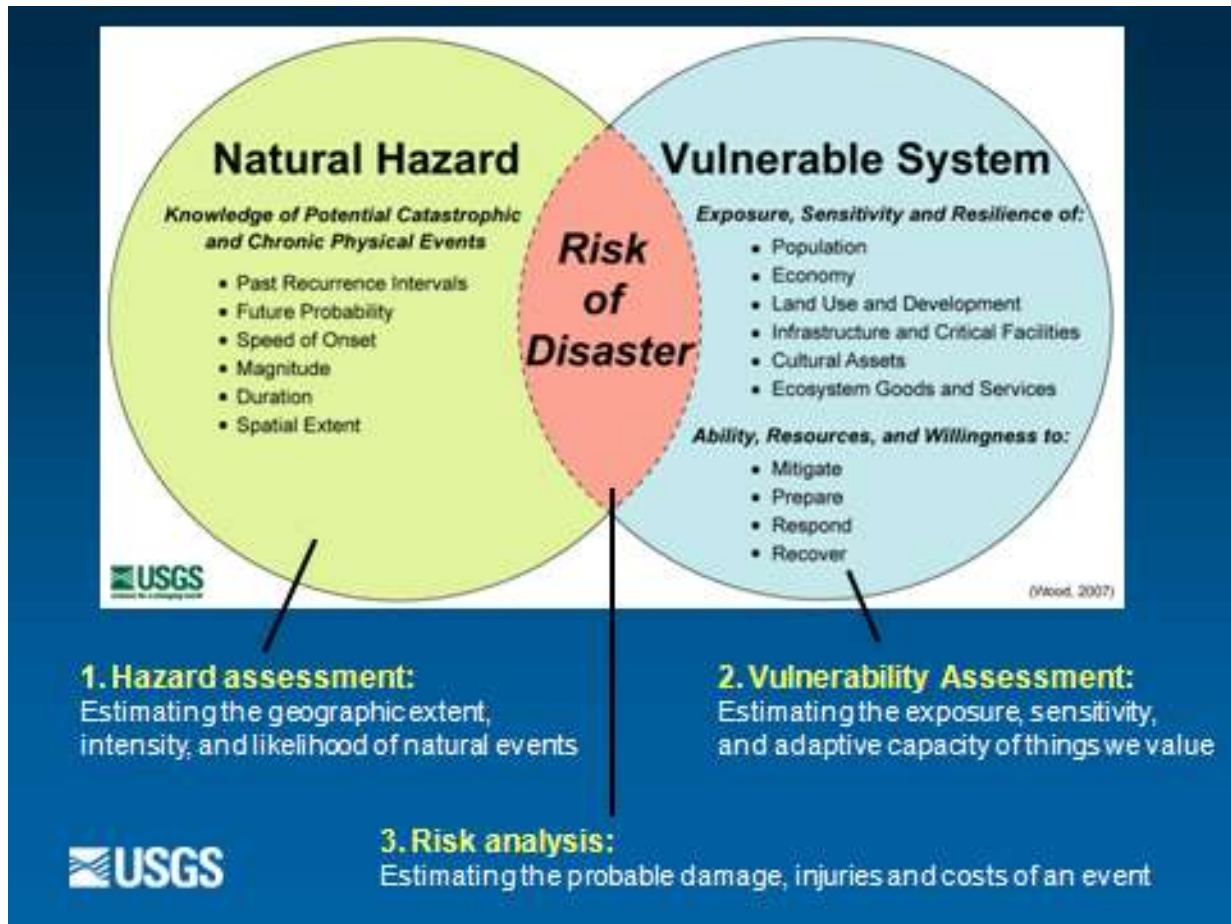
The team discussed various options for completing a qualitative risk assessment to rank the hazards, and after reviewing various criteria, decided on the five consequences of hazards described as follows:

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- ✓ Historical Occurrence – The number of times that the hazard has occurred in the community. Past events are one of the best indicators of the type and extent of losses that jurisdictions can expect to endure following future events. By determining historical occurrences, we are also able, to some degree, to help determine the probability of future occurrences.
- ✓ Probability- Likelihood/frequency of occurrence. What is the likelihood of the hazard occurring during a specified period of time? Or, how many times has the event occurred in the past? This assessment considers probability for a 50 year return interval.
- ✓ Vulnerability - Percentage of people and property that would be affected by the hazard. What percentage of people and property would be affected by the hazard event? Is it localized, such as a flash flood, in which case fewer people and a smaller area would be impacted, or is it wide spread, such as an earthquake, in which case more people and property are impacted.
- ✓ Spatial Extent - The area of the community that may be impacted. What is the geographical area impacted by the hazard? This can be based, in part, on the hazard profile; e.g., flood plains, liquefaction zones, lahar inundation zones, fault lines, Shakemaps demonstrating peak ground acceleration, etc. How much of the entire jurisdiction is impacted? Using the two scenarios above, a flash flood may have a smaller area of impact than an earthquake.
- ✓ Magnitude (Severity of Impact) – Assessment in terms of fatalities, injuries, property and economic loss. This describes the negative physical, economical, environmental and social consequences which can impact the jurisdiction – it tells us how severe the impact is upon the community in terms of fatalities, injuries, property or economic losses.

Combined, these elements produce the overall threat posed by the hazard. While it is a subjective estimation of the combined rating criteria, it nonetheless provides an analysis based, in part, on historical events and known potential impact(s) to provide some guidance with respect to mitigation activities and potential recovery needs.

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Source: Nathan Wood, PhD, Research Geographer, USGS. Presented during Risk Analysis training session. February 2010.

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**HISTORICAL OCCURRENCE** – Number of historical occurrences within community.

Rating	Adjective Description	Number of Historical Occurrences (within 50 years)
1	Low	<ul style="list-style-type: none"> <li>5 or few occurrences</li> </ul>
2	Medium	<ul style="list-style-type: none"> <li>6-9 occurrences</li> </ul>
3	High	<ul style="list-style-type: none"> <li>More than 10 occurrences</li> </ul>

**PROBABILITY** – Likelihood of the hazard occurrence, sometimes without regard to hazard history

Rating	Likelihood	Frequency of Occurrence
1	Rare	<ul style="list-style-type: none"> <li>Probability of occurrence one chance in the next 50+ years</li> </ul>
2	Low	<ul style="list-style-type: none"> <li>Probability of occurrence at least one chance in the next 25-50 years</li> </ul>
3	Medium	<ul style="list-style-type: none"> <li>Probability of occurrence at least one chance in the next 10-25 years</li> </ul>
4	High	<ul style="list-style-type: none"> <li>Probability of occurrence at least one chance in the next 1 to 10 years</li> </ul>

**VULNERABILITY** –Percentage of people and property that would be affected by the hazard event.

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	<ul style="list-style-type: none"> <li>Less than 5%</li> </ul>
2	Limited	<ul style="list-style-type: none"> <li>5% to 10%</li> </ul>
3	Critical	<ul style="list-style-type: none"> <li>10% to 25%</li> </ul>
4	Catastrophic	<ul style="list-style-type: none"> <li>More than 25%</li> </ul>

**SPATIAL EXTENT** –The geographical area of the community that might be impacted

Rating	Magnitude	Percentage of jurisdiction affected
1	Negligible	<ul style="list-style-type: none"> <li>Less than 10%</li> </ul>
2	Limited	<ul style="list-style-type: none"> <li>10% to 25%</li> </ul>
3	Critical	<ul style="list-style-type: none"> <li>25% to 50%</li> </ul>
4	Catastrophic	<ul style="list-style-type: none"> <li>More than 50%</li> </ul>

**MAGNITUDE (SEVERITY OF IMPACT)** – Assessment of severity in terms of fatalities, injuries, property/economic losses

Rating	Likelihood	Characteristics
1	Negligible	<ul style="list-style-type: none"> <li>Few if any injuries or illness</li> <li>Minor quality of life lost with little or no property damage</li> <li>Brief interruption of facilities/services less than 4 hrs</li> </ul>
2	Limited	<ul style="list-style-type: none"> <li>Minor injuries and illness</li> <li>Minor or short term property damage that does not threaten structural stability</li> <li>Loss of essential facilities and services for 4 to 24 hours</li> </ul>
3	Critical	<ul style="list-style-type: none"> <li>Serious injury and illness</li> <li>Major/ long term property damage; threatens structural stability</li> <li>Shutdown of essential facilities and services for 24 to 72 hours</li> </ul>
4	Catastrophic	<ul style="list-style-type: none"> <li>Multiple deaths</li> <li>Property destroyed or damaged beyond repair</li> <li>Complete shutdown of essential facilities/services for 3+ days.</li> </ul>

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The hazards with the highest total scores were considered the hazards of greatest concern for the state. The table below demonstrates the ranking of the nine natural hazards, with the priority hazards scoring highest and appearing in the shaded rows.

**Natural Hazards Qualitative Risk Assessment**

	Historical Occurrence	Probability	Vulnerability	Spatial Extent	Magnitude	Total	Rank
<b>Flood</b>	3	4	3	3	3	16	H
<b>Earthquake</b>	3	3	3	3	3	15	H
<b>Severe Storm</b>	3	4	2	2	3	14	H
<b>Wildland Fire</b>	3	4	2	2	2	13	H
<b>Tsunami</b>	2	1	1	1	3	8	M
<b>Volcano</b>	1	1	2	2	2	8	M
<b>Landslide</b>	3	3	2	1	2	11	M
<b>Avalanche</b>	3	4	1	1	1	10	M
<b>Drought</b>	1	2	1	1	2	7	L

Once the numerical ranking was completed, in an effort to remain consistent with the local jurisdictions as most utilize a High/Medium/Low ranking system, the total score was then converted to a High/Medium/Low method of priority ranking.

The breakdown of ranking is as follows:

- ✓ Low - Generating a total score of  $\leq 7$
- ✓ Medium - Generating a score of 8-12
- ✓ High - Generating a score  $> 13$

The resulting comparison for state and local risk assessment can be found in Tab 3 – *Coordination of Local Planning Efforts*.

### II. Assessing Vulnerability and Estimating Potential Losses by Jurisdiction and of State Facilities

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**Requirement 44 CFR §201.4(c)(2)(ii): *Plan Content.*** To be effective the plan must include an overview and analysis of the State's vulnerability to the hazards described in this paragraph §201.4(c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed.

**Requirement 44 CFR §201.4(c)(2)(iii): *Plan Content.*** To be effective the plan must include an overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

#### Development of Loss Estimates for State Facilities

Data on state facilities used in this plan comes from a state facility inventory developed by the State Office of Financial Management (OFM). State law requires OFM to maintain this inventory, and OFM annually solicits information from all state agencies to update their database. Previous OFM datasets included information on more than 11,000 state agency-owned and leased facilities statewide, ranging from comfort stations (bathrooms) at state parks to the Legislative Building (the state capitol building). Although it lacked information needed for a complete assessment of risk, such as occupancy and replacement costs, it was the best and most complete facilities dataset available.

During the 2009 Legislative Session, the State Legislature tasked OFM with the responsibility to gather much more detailed information (e.g., replacement values, personnel occupying facilities, etc.). OFM and EMD staff worked jointly to develop a list of required information to meet the needs of both departments, two of the most significant on the part of EMD being Latitude/Longitude information and replacement values. Other state planning initiatives including Critical Infrastructure Protection Planning also use this dataset. While efforts were ongoing to expand the information collected by OFM from state agencies to increase its usability by various planning initiatives and improve loss estimates from various hazard events, support behind this initiative were lacking until it was mandated by the State's Legislature.

In an effort to support this endeavor, EMD staff encouraged OFM to seek an HMPG grant to assist with the data collection, verification and input. During previous plan updates, EMD's Mitigation Strategist would gather facility information from OFM at the onset of its planning phase to work with state agencies in determining their vulnerability and establish their strategies, as well as use this data to determine potential dollar

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losses of state owned facilities. However, based on the Legislative requirement, it was decided that EMD would delay this portion of the plan update until OFM had an opportunity to complete the task, which was tentatively expected to be completed by January 2010. In March 2010, that information was released to EMD and was utilized in determining a much more viable loss estimation of state owned and operated facilities. A more detailed accounting of the facilities data collection project can be found in Tab 10, *Methodology*.

For the purposes of determining estimated value of at-risk facilities and their contents in previous plan editions, the EMD Mitigation and Recovery Section assumed a replacement value of \$100 per square foot for the buildings and another \$100 per square foot for furnishing, equipment, systems, and supplies. This assumption was developed following an analysis of replacement values used by HAZUS-MH, and determining that the values were applicable to many general government structures in the inventory.

The dataset utilized to run the 2010 risk analysis includes information on more than 8,554 state agency owned and leased facilities statewide. Previous plan editions estimated in excess of 11,000 facilities. During this update process, it was discovered that many of the facilities listed as being “owned” by the state were, in actuality, not. Additionally, in past FIS reports, the subleasing agency reported their lease and the master leasing agency reported the total leased space, thus double-reporting the subleased space. These changes and others reduced the number of facilities reported in 2010. Likewise, of the 7,201 owned facilities, other contributing factors also precluded their inclusion in the analysis as follows: outside the state - owned 2, leased 23; no lat/long or address provided - 13 owned; 1 leased.

The plan provides loss estimates for six natural hazards for which scientifically based, geo-spatial hazard zone information is available. These hazards are Earthquake, Flood, Landslide, Tsunami, Volcano, and Wildland Fire. Profiles for these hazards, and the hazard information in the regional profiles, include information on at-risk state facilities. Profiles on the three other hazards – Avalanche, Drought, and Severe Storm – do not have information on at-risk state facilities. The introduction to each of these hazard profiles provides an explanation on why no facility vulnerability information is included.

Various geo-spatial data for hazard zones were used in combination with geo-coded facility information from the OFM database to determine the state facility projected loss information. The dataset(s) used for each hazard is described in detail in Tab 10, *Methodology*.

Staff from the Military Department’s GIS section matched state facilities to hazard zones, and developed a list of potentially at-risk facilities. The EMD Mitigation and Recovery Section staff then provided results to participating state agencies for their use in developing mitigation initiatives for at-risk facilities, and used the information to populate tables on vulnerable facilities in both the Hazard Profiles and regional profiles.

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### Assessing Vulnerability by Jurisdictions

#### Analysis of Local Hazard Vulnerability

Reviewed for this analysis were the 48 new local hazard mitigation plans available to the State Emergency Management Division (EMD)'s Mitigation and Recovery Section as of January 31, 2010, as well as review of previously approved plans. For those jurisdictions whose plans have expired, the data from the previously approved plans were utilized. It is important to note that all jurisdictions within the state with the exception of Adams and Klickitat Counties were at some level in the planning process as of January 31, 2010 (e.g., awaiting grant award, in the process of selecting consultants to complete their plan, in the update cycle, etc.). Included in these plans were counties, towns, cities, and various types of special purpose districts. A list of all of the plans statewide and their categorization of vulnerability to hazards is detailed in Tab 5 – Appendix 1, beginning on page 20. Each of the plans' risk assessments were reviewed for specific local information that would improve the state plan's assessment of vulnerability, as well as determination of which jurisdictions were at greatest risk from the nine natural hazards addressed in the plan. A complete description of this analysis is in *Analysis of Local Hazard Vulnerability*, Tab 5, Appendix 1 of this plan.

The following observations come from the review of the local plans:

- Much of the information contained in the local risk assessments that describe hazards and vulnerability mirrors that which appears in the state plan, though in much less detail.
- Many local plans used and attributed information from the state plan's risk assessment, or used information from the same sources.
- Local plans in general did not appear to take advantage of information available from local planning departments regarding locations of frequently flooded areas and geologically hazardous areas. These are two of the five critical areas identified by state law that all cities, towns, and counties must develop land-use regulations to protect and limit development within.
- A review of the plans demonstrates an inconsistency in the method of determining risk and vulnerability; something which the State has known to be an issue, and something that has been the focus of several training sessions for the local jurisdictions, and the discussion topic of several SHMAT meetings. As a result, a new method of analysis is being utilized within the State's risk assessment this year, and a more in-depth example has been provided within the Risk Assessment section of the Plan contained in Tab 5.

Based on this review, changes to the 2010 SHMP risk assessment include:

- A focus on county-level risk assessment rather than county *and* city level assessment. This decision is based on the fact that many of the updated plans have become countywide or regional plans, rather than individual local plans, and the majority of all of the larger cities are incorporated into the county or

## Risk Assessment

regional plan. Conducting an analysis on a county level provides more consistency rather than comparing counties and cities individually.

- A new method of analysis will be utilized within the State's risk assessment, and a more in-depth example will be provided within the *Risk Assessment* section of the Plan contained in Tab 5.
- Make changes as necessary to update the criteria used to determine most vulnerable counties for all natural hazards profiled with the exception of drought and volcano, as those profiles were not updated during the 2010 update cycle..
- Make only minor changes in the 2010 assessment for counties most vulnerable to the wildland fire hazard. The assessment already uses a national-standard methodology used by all states for purposes of identifying local jurisdictions at risk to wildland fire for purposes of the National Fire Plan. However, for the 2013 plan update edition, the wildland fire hazard risk assessment will be reviewed in detail based on new studies and risk assessment being conducted by the U.S. Forest Service during the 2010-2013 update cycle.
- Include a profile for Climate Change. During the 2010 update process, a few jurisdictions had addressed Climate Change within their mitigation plans. Therefore, a basic profile will be included within the 2010 plan update.
- Prepare hazard profiles the SHMAP for three other man-made/ technological hazards which appear with frequency in the local jurisdictions' plans: public health, hazardous materials and dam safety.

### Analysis of Local Loss Estimates

The EMD Mitigation and Recovery Section staff also reviewed local plan risk assessments to determine whether information on the population and built environment vulnerable to various natural hazards could be used in the state's determination of jurisdictions most vulnerable to various hazards. The staff examination showed that only a few (17) of the plans reviewed included any projected loss estimates, and that provided information was not standardized. The state believes that the sample is insufficient in size, and the information provided too inconsistent, to include it in decisions that determine jurisdictions most vulnerable to hazards or to use to calculate a statewide loss estimate.

It should be noted that the federal regulations on local hazard mitigation planning do not require inclusion of such information in local plans [see 44 CFR 201.6.c.2.ii]; it is a "should" (i.e., optional) requirement rather than a "must" or "shall" requirement.

In its analysis, EMD staff focused on available local loss estimate data for three hazards – earthquake, flood, and tsunami. These hazards were chosen for examination for the following reasons:

## Risk Assessment

- Earthquake – it is one of the hazards of greatest concern to local jurisdictions and potentially the most damaging.
- Flood – it is one of the hazards of greatest concern to communities, one of the most frequently occurring hazards, and historically the most costly hazard to the state and its communities.
- Tsunami – It has been one of the most studied hazards in recent years, with modeling and inundation studies completed for nearly all at-risk communities along the Pacific Coast, Strait of Juan de Fuca, and the Puget Sound since 2000.

The primary difficulty in using the available local loss estimates are that they were developed without the benefit of a standardized methodology for each hazard. For example, for earthquake, Clark and Whitman plans used two different earthquake scenarios to generate loss estimates, while Grays Harbor and Thurston plans used the number of structures in areas at high risk to liquefaction. For tsunami, the Whatcom plan provides number of structures at risk without providing a value, while the Tulalip Tribe plan provides information on number of parcels at risk and their value. Flood loss estimates were the most complete, yet the methodology for determining losses differed; the Clark plan used a flood scenario similar to the 1995 flood event, while Grays Harbor and Whitman plans used the 100-year floodplain for their loss estimates, and the Renton plan used a 200-year flood event in the Cedar River.

The 2007 edition of the SHMP stated that the EMD Mitigation and Recovery Section staff would work with local planners as they began preparing updates to their plans during the 2007-2010 period to: 1) determine whether a standardized methodology could be developed for preparing local loss estimates, and 2) encourage more jurisdictions to include local loss estimates in their plans, even though they are not required by federal regulation at this time. By providing more viable data for their critical facilities as described above, as well as providing the template for a risk assessment, local jurisdictions have indicated that they will begin incorporating this information into their plans, when possible. The two training sessions provided during the 2007-2010 update cycle were also beneficial, as it provided several examples of different methods which can be used for conducting loss estimations and risk assessment. During the 2010-2013 update cycle, EMD Mitigation and Recovery Section staff will continue working with local planners as they continue preparing updates to their existing plans, as well as new plans, in an effort to enhance the loss estimation data.

The below tables demonstrate some of the loss estimates from local plans. Footnotes on each table describe the data used by local planners. It is noted that while some of the jurisdictions listed below are in the review stages for their 2010 plan edition, the latest *FEMA approved* plan was utilized to populate the data. In some cases, the data below may be different than that represented in the newly adopted plan as the approval date fell outside of the update cycle timeframe for data gathering. For jurisdictions utilizing any of the below information within their plan, review of the most current adopted local plan should be utilized.

## Risk Assessment

**Table 1. Earthquake Loss Estimates Provided by Local Plans**

Local Plan	Population			Structures				% Value At Risk
	Total	At Risk	% At Risk	Total #	Total Value	# At Risk	Value At Risk	
Skagit (1)	81,078	60,616	74.8%		\$ 5,020,684,107		\$ 3,028,452,917	60.3%
Clark (2)	345,238	15,805	4.6%		\$ 1,901,971,400		\$ 187,615,200	9.9%
Lewis (3)								
Whitman (4)					\$ 1,921,463,388		\$ 27,690,760	1.4%
Tulalip Tribe (7)(8)	9,246	9,246	100.0%	4,845	\$ 693,397,750	2,904	\$ 396,870,950	57.2%
Grays Harbor	22,620	6,282	27.8%	10,708	\$ 1,331,981,365	3,695	\$ 407,701,392	30.6%
Snohomish (6)					\$ 60,801,066,003	12,648	\$ 2,495,946,538	4.1%
Pend Oreille	22,070	21,615	97.9%					
Thurston (9)	231,100	99,200	43.0%		\$ 23,985,000,000		\$ 11,266,000,000	46.9%
Pierce (11)	700,729	64,285	9.1%	304,549	\$102,500,360,824	34,259	\$ 16,863,477,100	16.4%
Pierce – Unincorporated	239,052	44,009	18.4%	150,502	\$ 43,378,543,163	11,105	\$ 3,311,827,000	7.6%
Spokane (12)				137,000		16,830	\$ 1,529,700,000	12.3%
Franklin (10)	50,149	50,149	100.0%		\$ 1,453,043,090		\$ 1,453,043,090	100.0%

Note: Information shown is as presented in local plans; some totals have been calculated using OFM 2005 data

- (1) For jurisdictions reporting Population and Private Property Structure Values at risk (Mitigation 20/20) Data from 2004 plan.
- (2) At risk population is projected deaths, at risk structures are projected residential and bridge losses, from M8.5 Cascadia EQ
- (3) At risk population and property not provided in plan
- (4) Value of estimated residential and commercial property loss due to 500-year probabilistic earthquake
- (6) On NEHRP Class E soils
- (7) On NEHRP Class D soils
- (8) Number of parcels
- (9) Values include residential, commercial/industrial, government/institutional. Data gathered from Thurston County Hazard Mitigation Plan (pp. 4.1-20). September 2009.
- (10) Figures from those communities with an identified earthquake risk
- (11) Population figures are based on the 2000 Census. Structural values represent Pierce County data as gathered from Section 4 Pierce County Addendum Region 5 Hazard Mitigation Plan 2009-1013.
- (12) Values gathered from Spokane County Multi-Jurisdictional All Hazard Mitigation Plan (p.50). May 2007.

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**Table 2. Flood Loss Estimates Provided by Local Plans**

Local Plan	Population			Structures				
	Total	At Risk	% At Risk	Total #	Total Value	# At Risk	Value At Risk	% Value At Risk
Skagit	81,078	60,616	74.8%		\$ 5,020,684,107		\$ 3,028,452,917	60.3%
Clark (1)	345,238	15,805	4.6%		\$ 1,901,971,400		\$ 92,564,020	4.9%
Whitman (2)	42,500	1,490	3.5%		\$ 307,828,019		\$ 127,440,800	41.4%
Tulalip Tribe	9,246	1,613	17.4%		Projected property damage estimate \$21,178,915			
Grays Harbor (2)	22,620	4,660	20.6%	10,708	\$ 1,331,981,365	2,598	\$ 316,594,812	23.8%
Lummi Tribe					Vulnerable structures – 2,396; Projected property damage \$42,016,000			
Snohomish					\$ 60,801,066,003	9,627	\$ 1,053,024,903	1.7%
Pend Oreille	22,070	14,253	64.6%					
Thurston (5)	231,100	17,000	7.0%		\$ 23,985,000,000		\$ 1,561,000,000	6.5%
Pierce (6)	700,729	28,923	4.1%		\$ 102,500,360,824		\$ 15,601,153,170	15.2%
Pierce -								
Unincorporated	239,052	19,814	8.2%		\$ 43,378,543,163		\$ 7,711,372,300	17.7%
Franklin (4)	29,738	10,752	36.2%		\$ 1,109,611,074		\$ 1,026,528,696	92.5%
Spokane (7)						2,532	\$ 322,249,450	

Note: Information shown is as presented in local plans; some totals have been calculated

(1) At risk population is projected lives affected, at risk structures are projected residential and bridge losses, using 1995 flood as scenario

(2) At-risk population in 100-year floodplain, at-risk building stock in planning area

(3) 200-year flood event in Cedar River after late 1990s dredge of river, construction of flood walls, levies

(4) Figures from those communities with an identified flood risk

(5) Values include residential, commercial/industrial, government/institutional. Data gathered from Thurston County Hazard Mitigation Plan (pp. 4.1-20). September 2009.

(6) Population figures are based on the 2000 Census. Structural values represent unincorporated Pierce County data as gathered from Section 4 Pierce County Addendum Region 5 Hazard Mitigation Plan 2009-1013.

(7) No population data presented. Structural values represent Total Market Value of properties within 100 Year flood zone as gathered from Spokane County Multi-Jurisdictional All Hazard Mitigation Plan (p.57). May 2007.

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**Table 3. Tsunami Loss Estimates from Local Plans**

Counties/Communities with Identified Tsunami Hazard	Population			Structures					Area % Affected
	Total	At Risk	% At Risk	Total #	Total Value	# At Risk	Value At Risk	% Value At Risk	
Skagit	44,136	1,832	4.2%	22,641	\$3,738,875,762	1,331	\$196,296,317	5.3%	5.0%
Grays Harbor (1)	22,620	16,839	74.4%	10,708	\$1,331,981,365	7,908	\$1,046,854,479	78.6%	
Pacific (2)									
Jefferson (3)									
Clallam (3)									
Island (3)									
San Juan (3)									
Whatcom (4)						100			
Lummi Tribe (5)						2,107	\$103,077,000		
Snohomish (incl. Everett) (6)					\$60,801,066,003	1,339	\$946,813,600	1.6%	
Tulalip Tribe (7)	9,246	4,372	47.3%	4,845	693,397,750	2,208	\$359,590,250	51.9%	
King (3)									
Seattle (3)									
Pierce (9)	700,729	15,470	2.2%		\$ 87,047,171,174		\$4,292,697,900	4.9%	
Thurston (8)									
Mason (6)									
Kitsap (3)									
<b>Totals From Reporting Plans</b>	76,002	23,043	30.3%	38,194	\$66,565,320,880	12,886	\$2,549,554,646	3.8%	
<b>State Calculated Estimate</b>	<b>4,111,300</b>	<b>345,383</b>	<b>8.4%</b>	<b>This line uses OFM, NOAA Center for Tsunami Research population figures</b>					

Note: Information shown is as presented in local plans; some totals have been calculated

(1) Figures are from a "Low Potential" Tsunami event; such an event is not described in the plan, unincorporated area pop. Only.

(2) Hazard mitigation plan under development

(3) Plans provide basic narrative information on tsunami, but no information in at-risk population, structures.

(4) Provided estimates on number of structures at risk and area at risk to tsunami

(5) Value at risk is estimate of damage

(6) Provided information on parcels and value of parcels at risk; other impacts described in plan narrative

(7) Number of parcels at risk

(8) Did not address in initial plan

(9) Population figures are based on the 2000 Census. Structural values represent unincorporated Pierce County data as gathered from Section 4 Pierce County Addendum Region 5 Hazard Mitigation Plan 2009-1013.

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### Flood Map Modernization, Flood Control Assistance Account Program

An examination of the 2010 SHMP, floodplain mapping and management and flood control activities managed and/or funded through the State Department shows how the SHMP correlates with Ecology's flood-related activities.

Map Modernization – The Department of Ecology in 2000 became a Cooperating Technical Partner with FEMA in the Flood Map Modernization Program (called Map Mod for short). This program is a multi-year effort to update and digitize flood hazard maps throughout the state.

The Washington State Department of Ecology's Floodplain Management Program (Ecology) has received in excess of \$4 million from the Federal Emergency Management Agency (FEMA) in Cooperating Technical Partnership (CTP) grants over the past seven years. Ecology provided project and program management support to FEMA towards their Map Modernization and RiskMAP Programs. Ecology provided GIS expertise of digital mapping technologies, state liaisons with FEMA, mapping plans and strategies, the collection and analysis of data, contract management, consultation and coordination with other state and federal agencies.

An examination of the Flood Hazard Profile of the SHMP and the state's map mod program activities to date shows a correlation between counties identified as most at risk for flooding in the SHMP and Ecology-initiated map mod updates (see table below).

Flood Control Assistance Account Program – An examination of the 10 counties identified as most at risk for flooding in state plan and Ecology's disbursement of Flood Control Assistance Account Program (FCAAP) funds since 1985 shows how well the SHMP's counties most at risk determination correlates with Ecology's investment in floodplain management and flood hazard reduction activities (see table 4, below).

**Table 4. Comparison of Jurisdictions Most At Risk to Flood and Flood-Related Investments**

2010 State Mitigation Plan  Jurisdictions Most at Risk	Map Mod	FCAAP 1985 – 2009	
	Start Date	Rank SHMP	Funding
1. Grays Harbor County	2006	5	\$2,115,000
2. King County	2005	3	\$4,337,000
3. Lewis County	2005	1	\$1,570,000
4. Snohomish County	2006	1	\$3,568,000
5. Skagit County	2003	2	\$3,724,000
6. Pierce County	2003	4	\$4,760,000
7. Thurston County	2006	6	\$1,383,000
8. Cowlitz County	2006	7	\$995,200
9. Whatcom County	2003	6	\$2,573,000
10. Clark County	2003	8	\$985,000

Source: Washington Department of Ecology

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As of May 1, 2010 seventeen Counties in Washington State have been or are in the process of map modernization, as follows:

Adams	Clallam	Clark	Cowlitz	Ferry	Grant
Grays Harbor	Island	King	Kitsap	Lewis	Pierce
Skagit	Snohomish	Spokane	Whatcom	Yakima	

### Changes in Development

One of the requirements for state hazard mitigation planning is that the SHMP must review and reflect changes in development trends [44 CFR 201.4.d]. The intent of this requirement is to determine whether development trends since the approval of the 2007 SHMP have influenced which jurisdictions are:

- 1) most at risk to hazards, and/or
- 2) have those development trends influenced mitigation actions.

The timing required for review of the SHMP based on changes in development trends is problematic in Washington State. The reason for this is that the timeframe for revising the SHMP (three years) is much shorter than provided for local plans (five years), and for communities to revise local land-use planning initiatives, the primary drivers of local hazard mitigation. For example, by state law communities have seven years to review and revise state-required critical area ordinances, and comprehensive land use plans and development regulations; they also have 10 years to review and revise designated urban growth areas, into which new development is focused. At the time the 2007 SHMP was adopted (January 2008), all jurisdictions statewide were required to have updated their critical areas ordinance (defined within the capabilities assessment of Tab 6, *Strategy*). However, during the 2010 Legislative Session, the Legislature gave a three year extension for this update. The CAO is a vital element of mitigation within the State, and a requirement of the Growth Management Act (GMA). The update cycle for the GMA begins in 2014 (map of jurisdiction due dates is available in Tab 6, *Strategy*). Therefore, again, this data is not available for review and inclusion in the 2010 SHMP update.

While updated data is not available, it is nonetheless important to discuss at least some of the regulatory authority in place with respect to development trends. A more detailed list is available in the Capabilities portion of Tab 6, *Strategy*.

The Critical Areas Ordinance (CAO) is part of the Growth Management Act, and requires all cities, towns and counties in the state identify critical areas, and to establish regulations to protect and limit development in those areas. While the development under the GMA is optional based on the size of the jurisdiction and the speed at which they are growing, development of a CAO is not optional.

The CAO restricts development in five hazard prone areas:

- Wetlands

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- Areas with a critical recharging effect on aquifers used for potable water
- Frequently flooded areas (floodplains, and areas potentially impacted by tsunamis and high tides driven by strong winds)
- Geologically hazardous areas (those areas susceptible to erosion, landslide, seismic activity, or other geological events such as coalmine hazards, volcanic hazard, mass wasting, debris flows, rock falls, and differential settlement).
- Fish and Wildlife Habitat Conservation Areas

In coordination with the flood reduction element of the CAO, Washington State Department of Ecology (DOE) requires that jurisdiction develop a Floodplain Management Plan which addresses land use development in areas prone to flooding. In an effort to support this initiative, DOE is actively pursuing other activities and elements to advance the technical information and expertise of future floodplain management practices, these efforts include Map Modernization & RiskMAP, which will assist in acquiring precision topographic data.

Shoreline Management Act: Washington's 2003 Legislature required over 260 towns, cities, and counties with designated "shorelines of the state" to comprehensively update their Shoreline Master Programs by 2014. Most local programs had not been fully updated in over 30 years. "Shorelines of the state" generally refer to rivers, larger lakes, and marine waterfronts along with their associated shorelands, wetlands, and floodplains. Shoreline Master Programs carry out the policies of the Shoreline Management Act at the local level, regulating use and development of shorelines. Local shoreline programs include policies and regulations based on state laws and rules but tailored to the unique geographic, economic, and environmental needs of each community.

Given the limited available data, the EMD Mitigation and Recovery Section staff examined how changes in development should impact the SHMP. The staff used the following methodology:

- Change in population since 2007 was used as the indicator of growth and changes in development. Jurisdictions whose population grew the fastest during the last three year cycle were considered for further examination (see Map below).
- Staff compared the list of jurisdictions at greatest risk to various hazards in the 2007 SHMP to the list of the fastest growing counties and how those jurisdictions viewed their vulnerability as described in their hazard mitigation plans or a hazard assessment for their comprehensive emergency management plans (see table 6, below).
- Staff looked at how local hazard mitigation plans described their land uses and development trends per the requirement of 44 CFR 201.6.c.ii.C.

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- Staff examined local critical areas ordinances to see how those regulations addressed development in frequently flooded areas and geologically hazardous areas.

### Conclusions:

After examining these factors, the EMD Mitigation and Recovery Section staff found:

- The methodology used to determine jurisdictions deemed most at risk to natural hazards captured the fastest-growing counties (i.e., those with the greatest development pressure).
- The SHMP could not rely upon local hazard mitigation plans for descriptions of local development trends, as that requirement is optional in the federal planning regulations and most plans did not include such information.
- The state could not use loss estimates from local hazard mitigation plans as a factor when considering changes in development because there is insufficient information in local plans on which to base an assessment as previously discussed.
- The counties' critical area ordinances addressed new development in frequently flooded areas and geologically hazardous areas by identifying or requiring the identification of the hazard areas, requiring site investigations (for geologically hazardous areas), setting restrictions on development proposed for the identified hazard area, and, as necessary, requiring mitigation actions to protect life and property, depending upon the hazard area, and scale and type of proposed development. However, as this ordinance has not been updated as outlined above, the data has not changed since the 2007 plan update.
- The 2007 SHMP addressed local growth and development in two ways:

First, the SHMP, in Strategy 3.1.1., stated that the state hazard mitigation program would "provide grants, planning tools, training and technical assistance to increase the number of hazard mitigation plans and projects, especially in fast-growing communities." During the 2007-2010 update cycle the state increased the number of jurisdictions covered by or in the process of developing mitigation plans to 37, with only two jurisdictions remaining without plans. That increases the population covered in 2007 from 89% to 99% in 2010. The intent was to ensure the local jurisdictions had FEMA-approved hazard mitigation plans, as well as the tools and capability to develop hazard mitigation projects.

The second initiative in the 2007 Plan was to ensure successful grant funding applications for fastest growing counties. The process utilized during the 2009 cycle was to provide greater one-on-one technical assistance. Jurisdictions were encouraged to apply early, which would allow staff to review applications and provide assistance in filling gaps of missing data for mitigation projects. The second part to that initiative was to address the issue within the grant program's

## **Risk Assessment**

administrative plan. That change within the plan did not occur, but that initiative has been added as a new strategy (3.1.5) with a completion date of 2013.

### **Discussion:**

**Fastest-growing counties:** In determining the fastest-growing counties, EMD Mitigation and Recovery Section staff compared the population growth of the state's 39 counties. Population estimated developed by the Census Bureau and the OFM's Forecasting Division were used. Fifteen counties grew at a faster rate than the state from 2007 to 2009. The counties with a fastest rate of growth during 2007-2009 are depicted below.

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### Fastest Growing Counties by Population



Source: Washington State Office of Financial Management (OFM)  
 April 1, 2009 population estimates and 2000 U.S. Census data.  
 Created By: Cathy Walker, GIS Analyst  
 Washington Military Department - GIS Section  
 August 13, 2009

Rank	County	April 1 Population 2000	2009	% Change	Rank	County	April 1 Population 2000	2009	% Change	Rank	County	April 1 Population 2000	2009	% Change
1	Franklin	49,347	72,700	47.3 %	6	Snohomish	606,024	704,300	16.2 %	11	Douglas	32,603	37,600	15.3 %
2	Clark	345,238	431,200	24.9 %	7	Pierce	700,818	813,600	16.1 %	12	Grant	74,698	86,100	15.3 %
3	Thurston	207,355	249,800	20.5 %	8	San Juan	14,077	16,300	15.8 %	13	Mason	49,405	56,800	15.0 %
4	Kittitas	33,362	39,900	19.6 %	9	Whatcom	166,826	193,100	15.8 %	14	Island	71,558	80,300	12.2 %
5	Benton	142,475	169,300	18.8 %	10	Skagit	102,979	118,900	15.5 %	15	Spokane	417,939	465,000	11.3 %

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**Table 5.**  
**Washington's Fastest Growing Counties**

Rank	County	April 1 Population		%	Rank	County	April 1 Population		%	Rank	County	April 1 Population		%
		2000	2009	Change			2000	2009	Change			2000	2009	Change
1	Franklin	49,347	72,700	47.3 %	6	Snohomish	606,024	704,300	16.2 %	11	Douglas	32,603	37,600	15.3 %
2	Clark	345,238	431,200	24.9 %	7	Pierce	700,818	813,600	16.1 %	12	Grant	74,698	86,100	15.3 %
3	Thurston	207,355	249,800	20.5 %	8	San Juan	14,077	16,300	15.8 %	13	Mason	49,405	56,800	15.0 %
4	Kittitas	33,362	39,900	19.6 %	9	Whatcom	166,826	193,100	15.8 %	14	Island	71,558	80,300	12.2 %
5	Benton	142,475	169,300	18.8 %	10	Skagit	102,979	118,900	15.5 %	15	Spokane	417,939	465,000	11.3 %

Comparing hazard vulnerability – Next EMD Mitigation and Recovery Section staff compared on a hazard-by-hazard basis, how the SHMP's assessment of vulnerability to six hazards compared to the assessment of vulnerability in approved local plans (Table 6).

The six hazards chosen for comparison are earthquake, flood, landslide, tsunami, volcano, and wildland fire. These hazards were chosen because 1) earthquake, landslide, and volcano are among the geologic hazard areas that communities are to identify in their critical area regulations; 2) flood and tsunami and among the frequently flooded hazard areas that communities are to identify in their critical area regulations; and 3) wildland fire is one of the hazards of concern to the state, as determined by SHMAT and noted previously in this chapter.

In general, the state's determination of jurisdictions most vulnerable to hazards correlates to local determinations of vulnerability, with a couple of exceptions. (Note: The way the state and local jurisdictions determined vulnerability differed greatly. For example, the state used methodologies that included numerous parameters to determine vulnerability (see each Hazard Profile for details on methodologies used), while many local plans primarily used recurrence intervals to determine vulnerability (see *Analysis of Local Hazard Vulnerability*, Tab 5, Appendix 1 of this plan.)

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**Table 6. Comparison of Vulnerability / Risk to Natural Hazards as Determined in 2010 State Hazard Mitigation Plan and Approved Local Hazard Mitigation Plans**

Rank	County	Earthquake		Flood		Landslide		Tsunami		Volcano		Wildfire	
		State	Local	State	Local	State	Local	State	Local	State	Local	State	Local
5	Benton	Y	L	N	H	N	**	N	N	N	**	N	H
12	Clark	Y	M	Y	M	Y	M	N	N	N	L	Y	M
11	Douglas	Y	M	N	H	N	H	N	N	N	L	N	H
1	Franklin	Y	L	N	H	N	M	N	N	N	L	N	M
12	Grant	Y	L	N	M	N	M	N	N	N	L	N	M
14	Island	Y	H	N	M	Y	M	Y	M	N	L	Y	L
4	Kittitas	Y	H	Y	H	Y	H	N	N	Y (ash)	M	Y	H
13	Mason	Y	H	Y	H	Y	H	Y	N	N	L	Y	H
7	Pierce	Y	M	Y	M	Y	L	Y	L	Y (lahar)	L	Y	L
8	San Juan	Y	M	N	L	Y	**	Y	M	N	N	Y	L
10	Skagit	Y	H	Y	H	Y	M	Y	VL	Y (lahar)	M	Y	H
6	Snohomish	Y	1	Y	2	Y	4	Y	7	Y (lahar)	6	Y	5
15	Spokane	Y	L	N	L	N	L	N	N	N	L	Y	H
3	Thurston	Y	H	Y	H	Y	M	Y	**	Y (lahar)	L	Y	M
9	Whatcom	Y	H	Y	H	Y	H	Y	H	Y (lahar)	H	Y	H

**Legend:** Y=Most Vulnerable To Hazard (State Plan); H=High Vulnerability/Risk; M=Medium or Moderate Vulnerability/Risk; L=Low Vulnerability/Risk; VL=Very Low Vulnerability/Risk; 1-2-3-etc.=Numerical Rank based on projected estimated loss and probability of occurrence; Ash / Lahar=Volcanic hazard to which the jurisdiction is most vulnerable. **Shaded County**=No Local Hazard Mitigation Plan; information taken from local Hazard Identification and Vulnerability Assessment. N/A=Not Available. \*\* - Hazard not studied in initial hazard mitigation plan.

Hazard to which state plan and local plans differed significantly in their assessment of vulnerability were earthquake, flood, landslide and wildland fire.

For flood, several of the fastest-growing counties considered their flood vulnerability to be higher than the state assessment. All 39 counties have some level of vulnerability to flooding, as demonstrated by the fact that each county has been part of at least three Presidential disaster declarations for a flood event in the past 50 years. The state's assessment looked at a number of factors and applied them on a statewide basis to determine which counties were most vulnerable to the hazard. That the state and local assessments were not congruent does not mean the assessments were incorrect; most likely, it is that the local perception of flood vulnerability is higher in some counties than was demonstrated by the methodology used by the state.

For wildland fire, a large number of the fastest growing counties came up with a different assessment of vulnerability than the state. The state used a national assessment of vulnerability developed by the NFPA that identified Wildland Urban

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Interface High Risk Communities; this assessment was applied by DNR in 2004 to identify interface communities within the state. It appears that in the case of four counties – Benton, Douglas, Franklin and Grant – the NFPA assessment criteria did not find any high-risk wildland-urban interface communities. These counties, however, do have significant acreage of brush and crops, fuels that when dry burn quickly when ignited. In the case of three Western Washington counties – Pierce, San Juan and Snohomish – their rating of vulnerability based on frequency of occurrence was low, while the NFPA criteria found several wildland urban interface communities within them. Again, that the state and local assessments were not congruent does not mean any of the assessments were incorrect. This information may change during the 2010-2013 update cycle as a new study is underway by the NFPA which may change the risk rankings.

For earthquake, several of the fastest-growing counties considered their earthquake vulnerability to be lower than the state assessment. Of the 39 counties in Washington, 28 have some level of vulnerability to earthquakes. During the 2001 Nisqually Earthquake, all jurisdictions which the state indicated as having some level of risk to earthquake were declared, with the exception of Franklin, Spokane and San Juan counties.

For landslides, several of the fastest-growing counties considered their landslide vulnerability to be lower than the state assessment. This could be contributed to the fact that during the 2008-2009 series of winter storms which impacted our region, in excess of 1,200 landslides occurred statewide. Many of the jurisdictions which were impacted by those events are, as of the writing of this 2010 update of the SHMP, in the process of updating their own local plans, so the information has yet to be incorporated into their hazard profiles. During the 2010-2013 update cycle the risk attributed to landslides should become more uniform after jurisdictions are able to update their hazard information.

Local development trends – A review of the counties' hazard mitigation plans shows little information on local development trends that would be useful for an assessment by the state. The reason for this is that the federal regulation does not require this issue to be addressed in local plans; it is a "should" or optional requirement, rather than a "shall" or "must" requirement [44 CFR 201.6.c.2.C]. Therefore, there was little information available for the state to base an evaluation on outside of extensive research of the 281 cities and towns and 39 counties within the state. Also, as mentioned above, the major regulatory authority which influences development trends and mitigation activities are currently in the update process, but the expected date for completion of those updates is not set to occur until 2014.

As previously indicated, all jurisdictions were required to update their critical areas regulations by the end of 2008, but that did not occur. In updating their CAO, local governments must consider best available science in their identification and protection of those critical areas. State guidance to local government states that critical areas protection programs should address a number of issues, including:

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- Protecting members of the public, public resources and facilities from injury, loss of life, or property damage due to landslides and steep slope failures, erosion, seismic events, volcanic eruptions, or flooding.
- Maintaining healthy, functioning ecosystems through the protection of unique, fragile, and valuable elements of the environment.
- Directing activities not dependent on critical areas resources to less ecologically sensitive sites, and mitigating unavoidable impacts to critical areas by regulating alterations in and adjacent to those areas.
- Preventing cumulative adverse environmental impacts to frequently flooded areas.
- Local jurisdiction critical areas regulations differ by community, depending upon a number of factors. Nevertheless, an examination of the fastest-growing counties' critical area regulations shows that all require a site investigations prior to start of development in geologically hazardous areas; all set site-specific restrictions on development proposed for the identified hazard area; and all, as necessary, require mitigation to protect life and property for the proposed development, with the actions dependant upon the hazard area and its character, and the scale and type of proposed development.

## Regional Profiles

To understand the vulnerability of local jurisdictions to various hazards, profiles of the socioeconomic characteristics for nine geographic regions of the state were developed. The regional structure originally was developed in 2002 for bio-terrorism planning; it has been adopted by EMD for homeland security and hazard mitigation planning purposes. The regional structure organized the 39 counties of the state as follows:

### Region 1

Island  
San Juan  
Skagit  
Snohomish  
Whatcom

### Region 2

Clallam  
Jefferson  
Kitsap

### Region 3

Grays Harbor  
Lewis  
Mason  
Pacific  
Thurston

### Region 4

Clark  
Cowlitz  
Skamania  
Wahkiakum

### Region 5

Pierce

### Region 7

Chelan  
Douglas  
Grant  
Kittitas  
Okanogan

### Region 8

Benton  
Franklin  
Klickitat  
Walla Walla  
Yakima

### Region 9

Adams  
Asotin  
Columbia  
Ferry  
Garfield  
Lincoln  
Pend Oreille  
Spokane  
Stevens  
Whitman

### Region 6

King

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The Regional Profiles use information from the Washington OFM Forecasting Division and the U.S. Census Bureau's 2000 Census.

Each Regional Profile is divided into two distinct sections: the first provides a description of the region, and the second provides a synopsis of each natural hazard and how it impacts the region, and the state facilities identified as being at risk in that region.

Revision to the regional profiles – For the 2010 SHMP, the regional profiles were condensed and added to a general profile of the State of Washington. Narratives describing each county, its economy and commuting patterns were eliminated; the information was superfluous and not especially relevant to hazard mitigation. Population figures and median household incomes for each county were updated, using April 2009 data, developed by the State OFM's Forecasting Office. Hazard tables and loss estimates for each region were updated to reflect revisions made in the hazard profiles and determination of at-risk state facilities.

**Description of the region:** This section provides information on the geographic setting of the region, as well as a synopsis of a number of characteristics of potentially at-risk populations there, including:

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- Population of urban and rural areas.
- Population of ethnic groups.
- Primary language spoken, if other than English.
- Population of non-institutionalized disabled people.
- Population of senior citizens.
- Population of people living in poverty.
- Population of school-age children, kindergarten through 12<sup>th</sup> grade.

Information on the mix of housing between single-family homes and other housing types, the age of housing, and median household income also is provided.

Regional hazard descriptions: One-page synopses of six natural hazards – earthquake, flood, landslide, tsunami, volcano, and wildland fire – provides information on the characteristics of that hazard, identifies sources of the hazard or vulnerable areas within the region, provides history of hazard events in the region, if known, and describes probability of future events in that region, if known. The choice of these six hazards is described previously in this chapter. Information in each hazard description came from the Hazard Profiles and the documents used to develop those profiles as listed at the end of each profile.

At-risk state facilities: The synopsis below of at-risk state facilities was developed utilizing GIS overlays and analyzing information provided by OFM in its state facilities inventory database, and the state agencies that are participating partners in this plan.

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## State Owned and Leased Facilities Hazard Analysis



### Earthquake:

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	4687	\$4,240,907,574	\$904,823	64,494,019	13,760
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	2518	\$3,618,427,459	\$1,437,024	50,860,715	20,198
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	970	\$17,015,983	\$17,542	11,378,740	11,731
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	73	\$2,770,329	\$37,950	1,633,229	22,373



### Landslide:

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	42	\$2,473,894	\$58,902	123,666	2,944
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	12	\$754,830	\$62,902	82,727	6,893
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	0				
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	0				



### Flood:

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	482	\$46,153,571	\$95,754	1,389,869	2,883
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	118	\$18,560,405	\$157,291	670,147	5,679
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	66	\$674,320	\$10,216	496,513	7,522
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	1	\$11,178	\$11,178	8,463	8,463



### Tsunami:

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	87	\$3,945,317	\$45,348	209,797	2,411
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	4	\$102,579	\$410,319	12,886	3,221
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	40	\$355,919	\$8,897	290,868	7,217
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	4	\$75,456	\$12,576	44,150	7,358



### Wildland-Urban Interface (WUI):

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	943	\$172,244,586	\$182,655	3,019,014	3,201
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	194	\$133,005,845	\$685,597	1,752,206	9,031
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	35	\$178,910	\$5,111	145,741	4,164
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	4	\$14,369	\$3,592	14,176	3,544



### Volcano:

	# of Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
Owned:	122	\$17,320,943	\$141,975	261,305	2,142
	# of Essential Facilities	Total Original Cost	Avg. Original Cost	Total Square Feet	Average Sq. Ft.
	23	\$9,963,952	\$433,215	81,289	3,534
	# of Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
Leased:	24	\$186,448	\$7,769	144,770	6,032
	# of Essential Facilities	Total Monthly Rent	Avg. Monthly Rent	Total Square Feet	Average Sq. Ft.
	1	\$11,178	\$11,178	8,463	8,463

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**Datasets utilized for this analysis include:** Washington State Department of Natural Resources (DNR) Landslide database (facilities located within 500 feet), 2009; Tsunami Inundation Zone Maps for Washington, Washington State DNR, 2008; Lahar and Pyroclastic Flow Zones for Washington State Volcanoes (Mt. Baker (1996)[Case 1 & Case M zones], Mt. St. Helens (2004)[Zones 1M m<sup>3</sup>, 3M m<sup>3</sup>, 10M m<sup>3</sup>, 30M m<sup>3</sup>, and 100M m<sup>3</sup> flow volumes for VEI 2-3 and Zones 1M m<sup>3</sup>, 3M m<sup>3</sup>, 10M m<sup>3</sup>, and 30M m<sup>3</sup> flow volumes for VEI 4-5 eruption], Mount Rainier (1996)[Case 1 zone only], Mount Adams(1996)[lahar zone], and Glacier Peak(1996))[lahar zone], U.S. Geological Survey - Cascade Volcano Observatory; Washington Dept. of Ecology, Digital Q3 Data, FEMA Flood Hazard Zones, FEMA, 2003; Earthquake - USGS 2% Probability of Occurrence in 50 Years Map, 2008 (used areas with %g greater than or equal to 18% gravity based on Mercalli Index of VII (≥18%g) equaling strong shaking and building damage requiring repair); and Wildland-Urban Interface Communities, Washington DNR, 2004.

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<sup>1</sup> Wood, Nathan. (2010). USGS. Information presented during Risk Analysis Training held at Camp Murray, WA in February 2010.